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Journal of Applied Microscopy and Laboratory Methods

Vol. IV *April, 1901* *No. 4*

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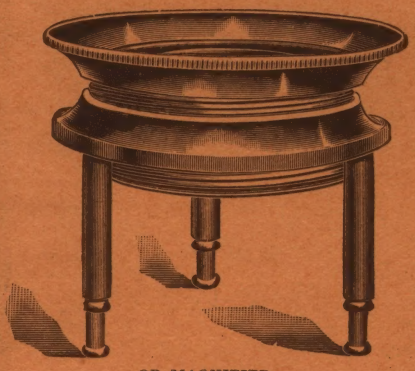

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Journal of
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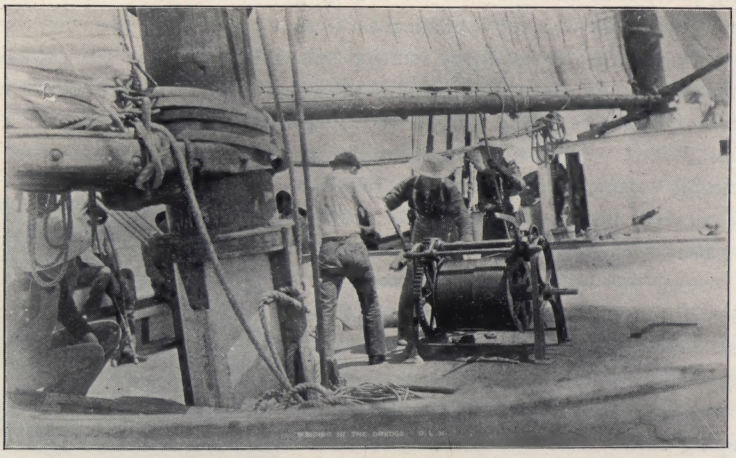
The Laboratory Equipment of the "Bahama Expedition" from the University of Iowa.

The problem which confronted the originators of this expedition was the very common one of getting the greatest possible educational results for a very small expenditure of money. The plan was to furnish a floating laboratory and home for a class of university students which should lack no really necessary thing for comfort and reap the best results from a scientific standpoint. It was determined, moreover, to work in the best possible field and to extend our operations

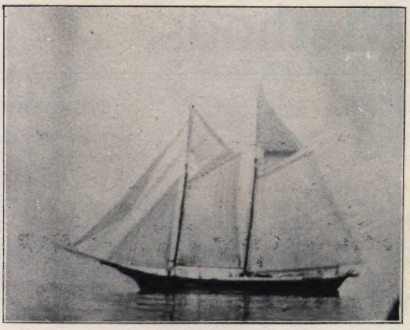


HAULING UP THE DREDGE.

down to a sufficient depth to reach the deep water fauna. That such a plan should originate in a university that is almost in the geographical center of the United States is not so strange as might at first appear, for the reason that we of the interior feel more deeply, perhaps, than our brothers of the coast, the immense advantage of study of marine life to those who would grasp fundamental biological facts, and if it was necessary to take a class over a thousand miles to reach salt water at all, we argued that we might as well go a thousand miles

farther while we were about it and reach one of the richest marine faunæ on earth, that found in the West Indian region.

In the choice of a vessel our poverty did us a real service in compelling the selection of a sailing vessel instead of a steamer. For such a service the sailing craft has several important advantages over the more modern type, and, so far as our experience went, very few disadvantages. In the first place our party would have required a much larger vessel if it had been necessary to provide room for engines and fuel for such a cruise, and with a larger vessel we could not have gone to some of the most delightful places that we visited. Again, the smoke, dirt and heat of a steamer would have been most uncomfortable in the heat of the tropics. On the other hand, it is remarkable how efficient wind propulsion is when the skipper knows his business, and ours did. A biological party is never at a loss for work in case the vessel becomes becalmed in the West Indian region. In such a case there is always enough animal life at hand to be secured with the dip-net or the tow-net worked from a row-boat if at sea, or by a landing party if at anchor. As for dredging, any sort of a wind will answer for that, and our work was fully as successful as it could have been with steam.



THE "EMILY JOHNSTON."
CHARTERED FOR THE "BAHAMA EXPEDITION."

Our vessel was an ordinary fruiting schooner from the Chesapeake, of the type known as a two-masted, double-topsail, centerboard schooner, with a net tonnage of 116 tons. She was 95 feet long, with 26 foot beam and a depth of hold of 7 feet. Although not notable for speed she was not slow, and was remarkably staunch and "dry" in rough weather. She had four state-rooms and a toilet room opening into a small cabin aft. The rest of the hold was ballasted with pebbles and a flooring was laid over the ballast. Along the sides of the hold were arranged the bunks for the men in two tiers with curtains in front like those in a sleeping car.

VISITORS ABOARD.

The stores, and these were gradually replaced by the collections, were stowed forward, leaving a large space between the stores and the after bulkhead for the laboratory, library, and dining-room. A door leading from the cabin to the hold divided the after bulkhead into two nearly equal parts. On one side of this door were the shelves for the microscopes, and on the other was the "library" containing the "Challenger" and "Blake" Reports, a number of text-books, and all the works concerning the sea that were contained in the university library. The

larger volumes were covered with black oil cloth and lettered with white paint, a most valuable precaution.

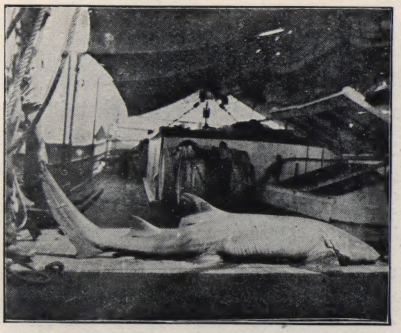
Two deal tables 20 by 4 feet, with ledges around them, accommodated the whole party either as dining or laboratory tables, the light from the sky-light being ample by day and four large swinging lamps serving at night, although but little laboratory work was done after dark.

SPOILS FROM LAND AND SEA.

A small dark-room for photographic work was enclosed on the starboard side next to the library shelving, and this room was as near purgatory in the heat of the tropics as one would be willing to endure, even in the cause of science.

The main, and altogether the most comfortable, laboratory was on deck. The cabin top was just high enough to serve as an excellent table to work at in a standing position, was almost flat, and large enough to accommodate the entire party at once when necessary. After we got into the warm region of the West Indies, this cabin top served as a bed for most of the party, and the bunks below were permanently deserted except in rainy weather, of which there was very little.

When at anchor the vessel was covered with an awning reaching from the foremast to the stern, and a cooler or more convenient laboratory would be hard to devise. Of course it was not provided with running water, but the very purest of sea water was easy to secure in any quantity by simply dipping it up in buckets. An abundance of tubs, buckets, tin pans and glass dishes was provided, as well as suitable instruments for dissection. We had a dozen laboratory microscopes of convenient type for dissection, and the same number of compound instruments, although it seldom happened that all of these latter were used at any one time. For any special investigation demanding a better instrument we had a high-grade microscope with a 1-12th oil immersion lens. Histological work, beyond the examination of fresh tissues, was out of the question, under the circumstances, and would have been less profitable than the study of living organisms even had it been practicable.



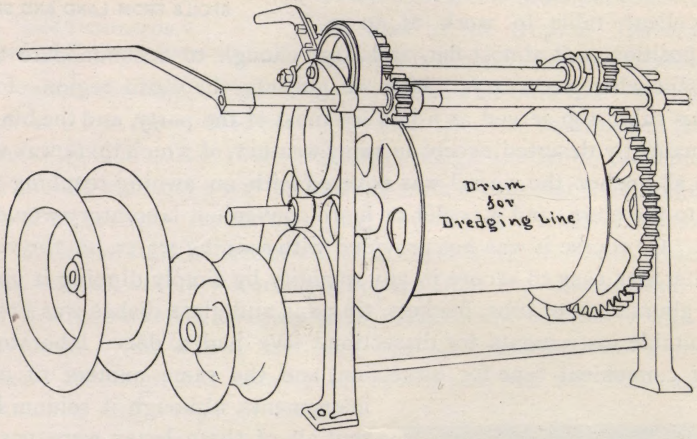
A CATCH.

As to our plan of work, it was, as is always the case where wisely directed, determined by the varying and unforseeable conditions that daily confronted us. In other words, we studied that which was at hand in greatest abundance, or that which seemed most instructive. When under sail we depended largely upon the dip-nets for material.

One day, for instance, was devoted to a study of the Sargosso weed and its

inhabitants. A better object lesson in the matter of protective coloration it would be impossible to find anywhere, the "weed" at first seeming to be uninhabited, but afterwards disclosing no less than twenty-six species to which it gave shelter and protection. On another day we were sailing through countless millions of the little medusa *Linerges mercurius*, carefully described and figured by Dr. Fewkes. Here was an excellent chance to become acquainted with the medusa structure. Again, we made a careful dissection of a species of shark which was wonderfully abundant near the Dry Tortugas; and one day our pilot ran the vessel aground on a sandy bottom thickly strewn with an immense starfish, *Pentaceros reticulatus*, which gave us the best possible chance to study the anatomy of the Asteroidea. Still again, we had the unique pleasure of studying fully expanded *Millepora*.

The more serious work of the expedition was in the line of dredging in comparatively deep water. Those who were informed in the science of deep water dredging were, for the most part, inclined to smile quietly, but still significantly,



REELS FOR SOUNDING LINE. HAND "CRAB" USED IN DREDGING.

at our audacity in undertaking such work without steam either for propelling the vessel or hoisting the dredge. Perhaps it was a case where "fools rush in," etc., but we were nevertheless entirely successful, and probably secured as many interesting things from the deep water fauna as any expedition has obtained in the same length of time.

Our equipment for dredging was, briefly, as follows:

The power necessary to handle the dredges, trawls, tangles, etc., was furnished by a hoisting machine technically known as a "crab," which was a sort of windlass worked by hand, constructed after plans devised by Professor Weld of the University of Iowa.

It consisted essentially of a horizontal drum fifteen inches in diameter and thirty inches long, resting on a heavy iron frame bolted to the deck. This drum was provided with a single and double purchase for cranks, by which a sufficient power could be applied to meet every demand likely to be made upon the machine. The lowering of the dredge was regulated by a powerful friction brake. Upon

the drum was reeled something over three hundred fathoms of cast steel rope, not a foot of which was lost during the entire trip.

Of course the reeling in of this rope with a heavy dredge at its end under the direct heat of the tropical sun was no child's play, and taxed the endurance of even the most enthusiastic. But it was done, and to good purpose. Incidentally, it may be remarked that in my opinion this work had a good deal to do with the excellent physical condition of the men during the cruise.

LETTING DOWN THE DREDGE.

Dredges of the regular "Blake" pattern were used. These and the trawls, also practically like those used on the Blake, were made in the engineering department of the university at surprisingly small expense. Trawls, however, are of little use where the bottom is rocky, as was the case almost everywhere in that region at a depth of from fifty to two hundred and fifty fathoms. By far the most effective instrument, and the one upon which we eventually depended almost exclusively, was the tangles, made after a pattern suggested by Dr. James E. Benedict of the National Museum. This proved such a decided success that I may be excused for giving its construction in detail. A four-foot length of 1 x 2-inch iron bar is bent in the middle at nearly a right angle. Five iron rings are bolted at regular intervals to the inner side of this bar, and to each ring is fastened a two-foot length of fairly heavy chain. Through each link of these chains is passed a six-foot strand of 2¾-inch Italian hemp rope, each strand being tied in the middle and thoroughly unraveled throughout its length. The dredging cable is attached to a hook bolted to the outer side of the angle of the bar. The amount of material secured by this device was astonishing, and included all sorts of things from corals to fishes, quite a number of the latter being secured in this way.

DREDGING ON "POURTALES PLATEAU."

Being provided with several of these tangles, we were able to economize time by detaching one from the cable as soon as it came up, and sending another down to be at work while we were picking over the first one. Many hands made this usually irksome labor light. Each student had a particular group of marine animals to look after, and he was responsible for the care of all of the material in his group, and had prepared himself to do just that work. The result was that the collections as a whole came through in very good shape.

We were astonished to find the amount of knowledge of the various groups

that was acquired from the mere handling of quantities of material, and sorting it out. Indeed, this seemed to me to be the most thoroughly educative factor involved in the expedition. Again, one must have the actual experience to realize the difference in the instruction derived from museum specimens and those taken fresh from their proper habitat. For instance, we were all astonished at the bright colors of the deep-sea forms, and impressed with the manifestly adaptive nature of these colors, because not only a given species but also the associated forms were brought up together, making manifest the fact that these colors were very often protective.

Such facts would never have been suggested by the study of museum specimens, no matter how abundant and well preserved they might be.

Of course we had to depend almost exclusively upon alcohol as a preservative, formalin not having yet come into use. An excellent device for saving alcohol and weight was carried into effect at the suggestion of Dr. Benedict. This was simply to take specimens after they had been for a few days in alcohol and solder them up in large tin pans, two of which were soldered together by their broad flat rims. These pans were both square and round, and could be conveniently crated when sealed. Specimens preserved in this way often came through in better shape than when left in alcohol.

It may be of interest to some of your readers to be informed that the entire cost of this expedition to each member was almost exactly two hundred dollars, including fare from Iowa City to Baltimore and return, and every necessary expense during a three months cruise. There was no accident or misfortune of any kind, and no sickness except the inevitable sea-sickness.

C. C. Nutting.
State University of Iowa.

A Description of the New Wing of the Laboratory of Hygiene at the University of Pennsylvania.

As an immediate result of the increasing interest in the science of bacteriology, the construction of suitable laboratories for its pursuit has come to be a subject of no little importance. At present there is of necessity more or less experimenting in this line, and the results obtained by one institution are of value to other institutions contemplating the erection and equipment of laboratories and lecture-rooms for the work.

Dr. A. C. Abbott, Professor of Hygiene and Bacteriology at the University of Pennsylvania, has recently contributed a detailed description of the new addition opened a year ago for the instruction of bacteriology in that institution. In planning the building, the primary object was to provide a lecture-room with seating capacity for not less than three hundred students, and a laboratory sufficiently large to accommodate not less than seventy-five students working at one time. Externally, the structure as completed is of red brick trimmed with brown stone and terra cotta, and two stories high; conforming in lines and finish to the original building. Internally there were three features of construction

Fig. 1.—Lecture room, looking toward the instructor's table.

which were insisted on, and which there have been thus far no reasons to regret. They are: hardwood floors, steel ceiling for the lower room, and walls devoid of plaster. Hardwood floors were adopted more for economy than elegance, maple being preferred to yellow pine as it is less apt to splinter with hard usage, even though it is given much less care. The floors are well laid, stained, oiled and varnished.

Experience has shown that plaster ceiling is liable to fall at any time should, through accident, which is not rare, the floor of the room above become flooded with water. Plastered walls, unless painted, become soiled very quickly, and are difficult to clean; and if painted, this must be repeated from time to time, thus incurring constant expense. The objections that bare brick walls reflect less light, and favor the condensation of moisture upon them, are readily met by the use of light colored, smooth brick, and laying them with an air space between external and internal walls.

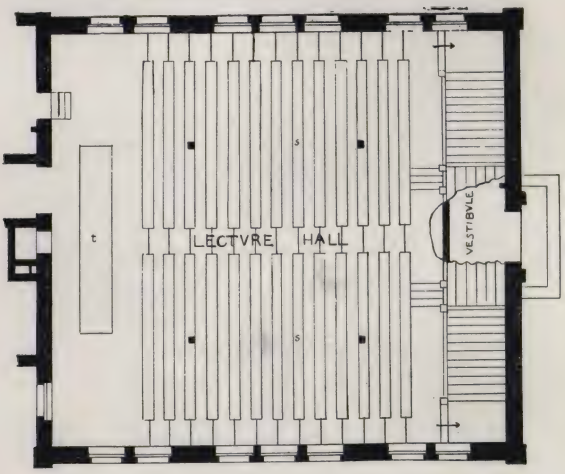


Fig. 2.—Lecture room. (s) seats; (t) instructor's table.

The first floor is occupied by a lecture-room 52 x 56 feet, to which students gain access directly from without through a vestibule doorway, while the instructor may enter behind the lecture-table directly from the laboratory hallway, or, by a door to the left of this, from the adjoining preparation room. (See Figs. 1 and 2 for general arrangement.)

The seats, with a capacity of 310, extend straight across the room, rising on 8- to 9-inch steps from the lecture-table to within 9 feet of the opposite wall. They are comfortable church pews of oak, with antique finish, 2′ 8″ from back to back, and each one subdivided by cast-iron arm rests 19″ apart; the object of this being to ensure sufficient room for comfort to each individual, and also to discourage any tendency on the part of the occupants to lounge. There is a center aisle of 2′ 8″, and an aisle 3′ 6″ in width along each lateral wall. The ceiling, 17′ 6″ high at the point occupied by the instructor's table, is of paneled steel, painted with zinc paint to match the lighter parts of the walls, which are

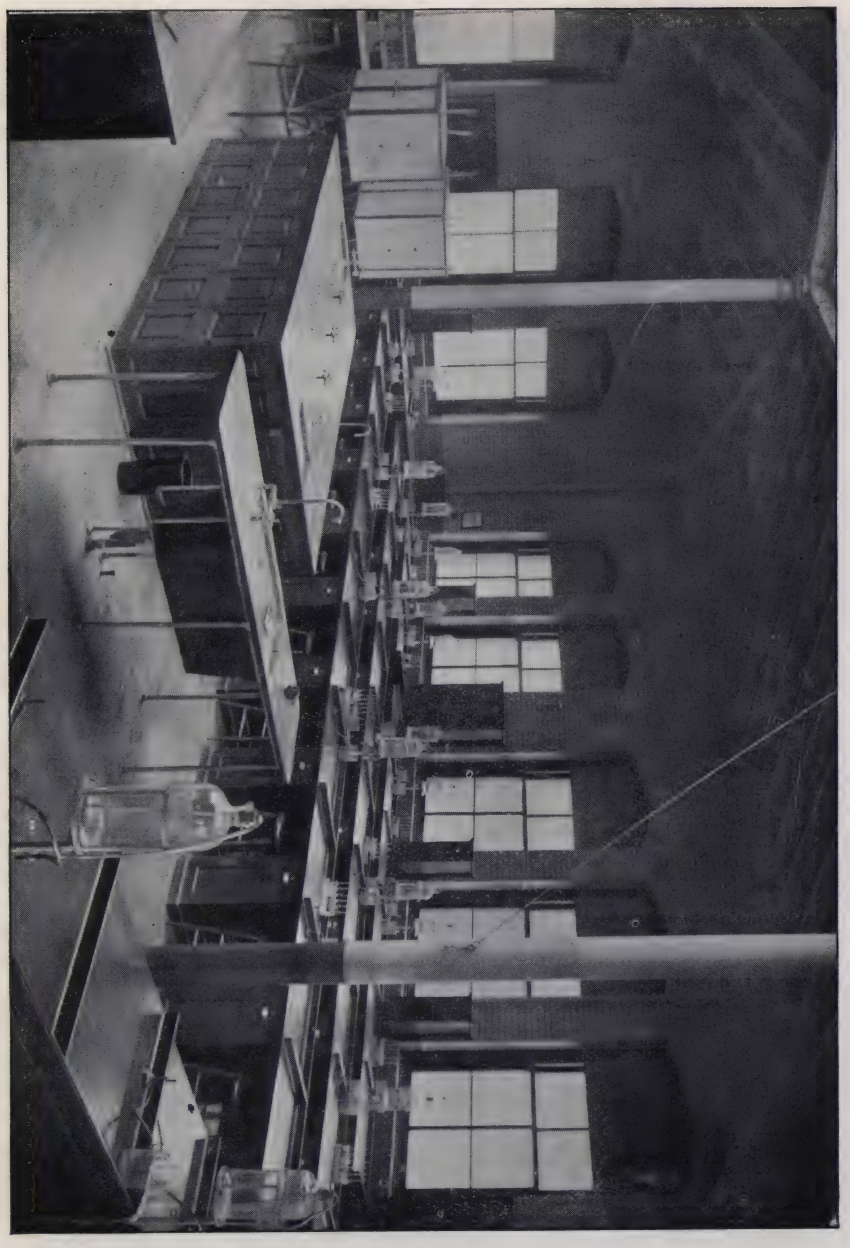


Fig. 3.—Laboratory, showing arrangement of desks, tables, etc.

of light buff pressed brick, laid in mortar of corresponding color, and smoothly finished. For a distance of five feet above the floor the color of the brick is a chocolate.

Illumination is supplied by rows of windows extending up to the ceiling on the east and west walls; in addition to which electricity is provided for use on dark days and at night.

Ventilation is through a large stack heated by steam coils. Heating is in part by direct radiation from steam radiators, and in part indirectly from large steam coils placed beneath the perforated stairways entering the room. Besides a large lecture-table provided with gas, water, and sinks, the instructor has at hand movable racks for the exhibition of diagrams used in the lectures.

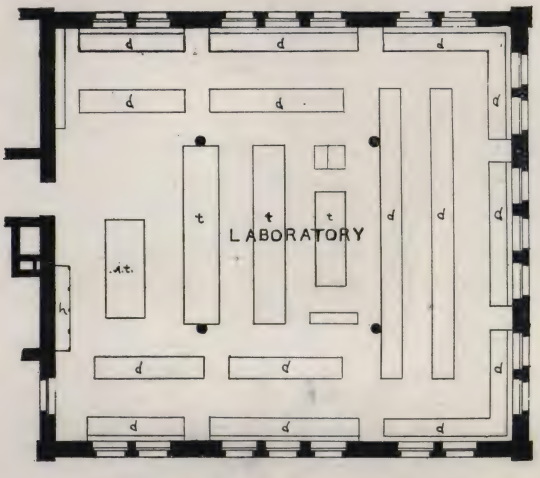


Fig. 4.—Laboratory. (d) desks for microscopical work; (t) tables; (i. t.) instructor's table; (h) hood.

A laboratory for practical work in bacteriology occupies the second floor, immediately above the lecture-room. The walls and floor are similar to those of the room below. The ceiling increases in height from the walls, where it is 14 feet, to the center of the sky-light, where it is about 24 feet. With a large sky-light, and with windows in the three walls, the illumination of this room is all that could be desired. The room is heated by steam, is well ventilated, and has a capacity of 83 students working at one time. The arrangement of the desks may be seen in Figs. 3, 4, and 5. Parallel with the east and west walls are two rows of desks with an aisle of 5 feet between them, while across the southern end there are three such rows separated by aisles of 3′ 6″. These desks, each one 3′ wide, 2′ 3″ deep, and 2′ 8″ high, are made of poplar, and are joined together in sets of from four to six, as convenience required. On the low partition (about 2″ high) dividing one desk from another, are gas and water, the latter being syphoned from large bottles, held in suitable iron racks. This plan is regarded as preferable to water-taps from the regular house supply, as the latter, even though filtered, is often objectionable, while the bottles can always be kept filled with distilled water. It also eliminates the frequent annoyance of

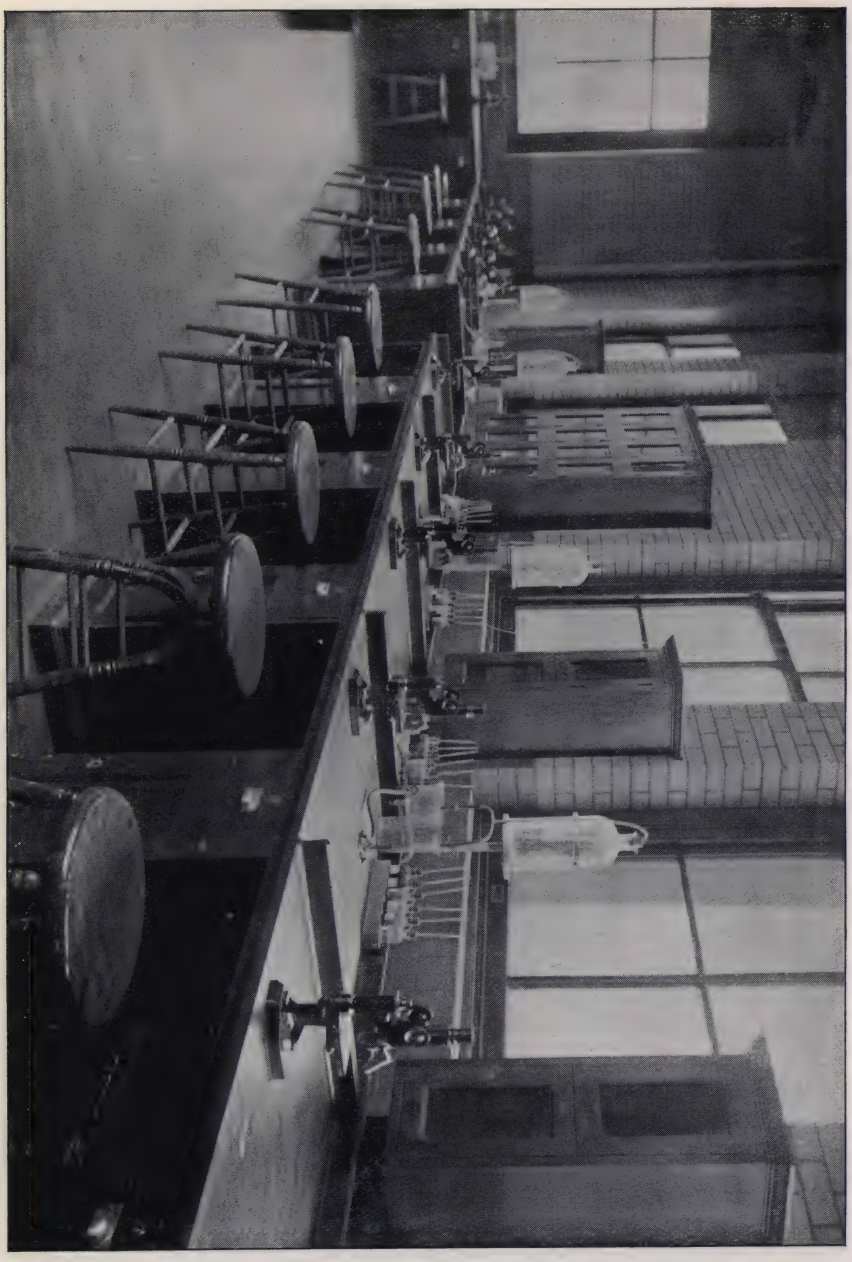


Fig. 5.—Desks for microscopical work.

obstructed drain pipes. Each desk is supplied on the right hand side with a drawer and locker one foot wide, extending through the entire depth of the desk; while beneath the top of the desk and well out of the way is a shelf, inclined toward the back, and large enough to accommodate an overcoat and a hat, thus obviating the necessity of special coat lockers.

The bodies of these desks are, like all other wood fittings of the room, finished in the natural color of the wood, oiled and varnished. The tops of all desks and of the tables in the room are finished in black, with lamp-black and paraffin. This finish has been found superior for laboratory purposes to any other, and is obtained by rubbing into the freshly dressed desk top a mixture of lamp-black and turpentine until the wood is thoroughly soaked with it. All excess of the black is then carefully removed by thorough rubbing with cotton waste, or with old rags. After this, paraffin of a high melting point is ironed into the wood with a hot iron. The excess of paraffin also is finally removed by thorough rubbing. The result is a comparatively dull black finish, very restful to the eyes, an excellent background, and a finish that is not injured by the ordinary chemicals, staining solutions, or warm objects that may get upon it. Under no circumstances should a laboratory table or desk be varnished. The tops of the desks are not screwed or nailed to the bodies in the ordinary manner, but are held in place by screws passing through slots in such a way as to allow the wood to shrink without cracking. There are no angles to tops of desks, all corners being rounded to facilitate cleaning.

On three walls of the room are glazed lockers for microscopes, each one bearing a number to correspond with a desk. The glazing of the lockers admits of ready inspection of contents by the instructor, without his being obliged to open the lockers. Each student on entering the laboratory for work is supplied with a desk, a locker and the keys for the same, for all of which he is held responsible. The equipment of each desk consists of a microscope of approved pattern, including an oil immersion lens, staining reagents, test-tubes, dishes, funnels, flasks, a gas stove, a Bunsen burner, and in short all the apparatus, except slides, coverslips, towels, notebooks, etc., that are necessary to pursue the course. No charge is made for any apparatus unless injured or destroyed.

In addition to the desks there are four large tables in the laboratory that are used for such work as the preparation of culture media and the demonstration of autopsies, dissections, etc. These are supplied with sinks, hot and cold water, and gas. Beneath these tables are lockers for the use of students, each locker being numbered to correspond with a particular desk.

On the north wall of the room are the necessary shelves and closets for apparatus and materials, and to the right of the door leading into the room is a commodious glass hood, the framework of which is of iron, the base of soapstone, and the back of brick. This hood is provided with gas, water, and aspirating flues. The glass inclosing such a hood should never be cemented firmly in the frames, as it is sure to crack by the expansion and contraction of the surrounding metal. It should be either loosely set, or set in some elastic material, that will relieve the strain upon it. The total cost of the addition to the original building was a trifle over fifteen thousand dollars ($15,001.25). C. W. J.

LABORATORY PHOTOGRAPHY.

Devoted to methods and apparatus for converting an object into an illustration.

THE VALUE OF THE TELEPHOTO LENS.

The value of the telephoto lens to the naturalist has been shown in many ways. Photography has reached such a stage that it is impossible for a naturalist to do without it. In order to do the best work it is necessary to carry several lenses, or combinations which will produce both long and short focus, depending on the object to be taken.

PHOTOGRAPH MADE WITH ORDINARY PHOTOGRAPHIC LENS.

PHOTOGRAPH MADE WITH SAME LENS AND THE TELEPHOTO.

The accompanying pictures show how a telephoto lens was necessary to secure a picture of an osprey's nest which was in the top of an old pine tree, around the base of which there was a dense jungle of underbrush. The view

shown across the river is the only view to be had of the nest from this near distance without having the foreground so full of limbs as to obscure the nest.

The location is on the north end of Flathead lake, in western Montana. The nest is in front of the University of Montana Biological Laboratory, which is immediately behind the illustration. That is, it is at the photographer's back. The river in the foreground is Swan river, or Big Fork. It is swift and turbulent. There is no place on the opposite shore where the camera may be placed so as to take in the nest. The nest is about a hundred feet from the ground.

The picture with the nest small was taken on a Seed orthochromatic plate, on a cloudy day when rain was falling. Without changing the camera the telephoto lenses was added, and the camera was pointed so as to put the nest in the middle of a five by eight plate, and the magnification raised to five. Naturally the exposure was porportionally longer. The sky was overcast, and rain was falling. Indeed, it was necessary to notice that water did not get on the lens. Only the small opening seen between the trees was taken by the telephoto, and the background was clouds. While a longer exposure would have produced a better result for definition, the two pictures show how inaccessible objects become accessible by the use of this lens.

The pictures were taken in August, 1900. Many of these nests are found in this vicinity, and it is said this nest has been used by wild geese in times past. The nest has been used by ospreys for two years past, the birds being the objects of study by the students at the summer laboratory.

University of Montana. MORTON J. ELROD.

MICRO-CHEMICAL ANALYSIS.

XII.

THE ANALYTICAL REACTIONS OF GROUP II.

Ca, Sr, Ba, — Gl, — Mg, Zn, Cd, Hg.

CALCIUM.

The following reagents will be found to be the most useful of those which have been proposed for the detection of this element:

I. Sulphuric acid.
II. Oxalic acid.
III. Sodium tartrate.
IV. Potassium ferrocyanide.
V. Arsenic acid.
VI. Primary sodium carbonate ($HNaCO_3$).

I. Dilute Sulphuric Acid added to solutions containing salts of Calcium, leads to the separation of hydrated Calcium Sulphate.

$$CaCl_2 + H_2SO_4 = CaSO_4 \cdot 2H_2O + 2HCl.$$

Method.—To a drop of the solution to be tested, add a tiny drop of sulphuric acid. In a few moments monoclinic crystals of calcium sulphate begin to form

near the circumference of the test drop as exceedingly slender, colorless, transparent needles, either singly, in sheaves, or in star-like clusters (Fig. 43). When in tiny sheaves near the edge of the drop the crystals have often a more or less brownish tint when seen by transmitted light. Shortly after the appearance of the bunches of needles at the periphery, long, thin, slender and plate-like prisms with obliquely truncated ends are formed throughout the drop. These prisms are frequently twinned, yielding so-called arrow-head or swallow-tailed and X-like twins. These twin crystals are the most characteristic of the forms assumed by calcium sulphate of the formula $CaSO_4 \cdot 2H_2O$.

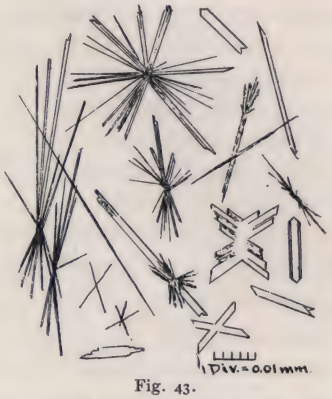


Fig. 43.

Remarks. — The sulphuric acid employed should be dilute and should not be added in excess. Sulphate of sodium or of ammonium may also be employed, but less advantageously.

The best results seem to be obtained when the reagent is added to a dilute neutral solution. If no crystals are visible after waiting a short time, the preparation may be cautiously concentrated. This procedure (evaporation) may, however, lead to the separation of such an amount of other salts as to render difficult the detection of the crystals of calcium sulphate. A better plan is to hasten the separation of the calcium salt by exposing the test drop to the vapor of alcohol. This is conveniently performed as follows: place a small bit of filter paper on the slide, a few millimeters from the test drop, invert a 25 mm. watch glass over the drop in such a way that part of the filter paper is included under the glass (see diagram, Fig. 44), add sufficient alcohol to the part of the filter paper outside the glass to completely saturate it, no more. If the test drop is situated at the corner of the slide, as is usually the case, place another slip alongside to support the watch glass, as is shown in the diagram. Allow the preparation to stand a few seconds, remove the glass and paper, and examine.


Fig. 44.

Strong acids should be absent. In the event of their being present add ammonium acetate, or, better, carefully evaporate the solution to dryness, if possible, and take up the residue with water.

It must be ever borne in mind that in the presence of an excess of salts of Group I, the solubility of calcium sulphate is usually so greatly increased that the detection of calcium by this test is sometimes difficult.

A more serious interference is that of the chlorides of the trivalent metals. In the presence of these salts it is generally advisable to proceed as follows: Add to the somewhat dilute solution, ammonium acetate, heat to boiling, but avoid long or violent ebullition, since in the latter case the precipitate formed often refuses to settle. The clear liquid is then separated from the precipitate by drawing off on the slide, filtration, or by means of the centrifuge, is concentrated if necessary, and tested for calcium with sulphuric acid.

Sulphuric acid added to salts of strontium may, under exceptional conditions (if the preparation be examined at once), yield a precipitate which closely resembles that given by calcium. These crystals of strontium sulphate rapidly disintegrate, however, and there results a fine granular deposit. This granular or sandy precipitate is the form assumed by strontium sulphate under the conditions which ordinarily obtain in this test. Barium is immediately precipitated in an exceedingly finely divided condition, amorphous in appearance. Any lead which may be present will also be precipitated as a dense white amorphous powder.

If calcium sulphate be heated with a drop or two of sulphuric acid until white fumes (SO_3) are given off, and the preparation allowed to cool, the calcium will separate either as the salt $CaSO_4$ or as $CaSO_4 \cdot H_2SO_4$. The crystal forms most frequently met with are shown in Fig. 45. This modification of the test is not satisfactory for calcium, but is characteristic for barium and strontium (q. v).

It is not always wise to conclude that calcium is present when crystals separate on the addition of sulphuric acid, which apparently resemble the star and sheaf-like aggregates of calcium sulphate, even if the crystals exhibit oblique extinction. For it sometimes happens that other compounds, not calcium sulphate, separate in forms not to be distinguished, at first sight, from the crystals of the calcium salt. Such instances are fortunately very rare.

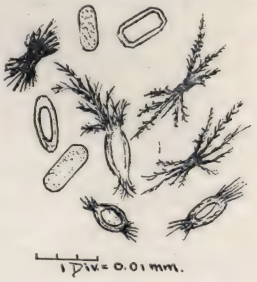


Fig. 45.

It has been proposed to check this test as follows: After allowing sufficient time for the separation of almost all the calcium as $CaSO_4 \cdot 2H_2O$, draw off the supernatant liquor; add to the residue a solution of ammonium carbonate; the crystals of calcium sulphate are dissolved and highly refractive rhombs and grains of calcium carbonate appear, which are easily found by examining the preparation between crossed nicols. A high power is generally required.

In the presence of borates, calcium cannot be satisfactorily detected by means of sulphuric acid. In such an event Method II can be employed.

Exercises for Practice.

(See methods and exercises given under Strontium and Barium.)

Try reaction, after the manner given above, on salts of calcium in neutral solution.

Try the effect of precipitating in the presence of free hydrochloric acid; then in the presence of free nitric acid.

Precipitate with dilute sulphuric acid, then heat, adding more acid if necessary, until white fumes are given off, cool, breathe on the preparation and examine.

Try testing for a trace of calcium in the presence of a large quantity of salts of the elements of Group I.

Try effect of a solution of ammonium carbonate on crystals of calcium sulphate.

II. Salts of Calcium give with Oxalic Acid a difficultly soluble Calcium Oxalate.

$$CaCl_2 + H_2C_2O_4 = CaC_2O_4nH_2O + 2HCl.$$

Method.—A drop of a solution of oxalic acid is caused to flow into a drop of the solution to be tested. The solution of the substance should be neutral or may contain a trace of free nitric acid. Calcium oxalate is almost instantly precipitated in the form of tiny highly refractive octahedra or rhombs. Often crosses and more or less irregular bundles of minute needles are obtained (Fig. 46).

Fig. 46.

Remarks.—The composition of the salt, with respect to the amount of water of crystallization, varies according to conditions. It seems to be quite generally accepted that when precipitated from neutral or alkaline solutions at room temperature the salt formed has the formula $CaC_2O_4 \cdot 3H_2O$ and is to be referred to the tetragonal system; while if precipitated from hot neutral or acid solutions or from acid solutions at room temperature there is obtained an oxalate of the formula $CaC_2O_4 \cdot H_2O$, a monoclinic salt. This latter form of calcium oxalate seems also to result in the presence of an excess of oxalic acid. It follows, therefore, that with the conditions which usually obtain, there may be precipitated either the salt with three molecules of water of crystallization or the salt with only one molecule.

Free nitric acid greatly retards the reaction, but the presence of a very little of this acid gives rise to the formation of larger crystals (because of their being more slowly formed), which are therefore more easily recognized.

Calcium oxalate is insoluble in acetic acid and in sodium, potassium and ammonium hydroxides, but is readily dissolved by the mineral acids.

Strontium gives with oxalic acid an identical reaction, save that the crystals of strontium oxalate are generally somewhat larger.

Barium oxalate takes the form of fibrous bundles of needles and is not likely to be mistaken for either calcium or strontium.

Zinc under certain conditions may yield a zinc oxalate difficult to distinguish from the oxalates of calcium and strontium.

Magnesium oxalate will separate in forms not to be distinguished from calcium oxalate if the test drop contains much acetic acid.

Lead oxalate may also assume forms somewhat resembling those of calcium oxalate, but after a short time these crystals grow into large, well developed prisms.

Many other elements are also precipitated by oxalic acid. If such elements are present in large amount they are apt to interfere.

Owing to the minute size of the crystals, testing for calcium with oxalic acid is not always satisfactory. As an offset to this disadvantage, chlorides of the trivalent metals and boric acid have no effect other than a retardation of the reaction.

In the event of a precipitate of doubtful composition being obtained, draw off the supernatant liquid, or separate by means of the centrifuge, add to the residue a tiny drop of dilute sulphuric acid. Calcium oxalate is dissolved and in a few seconds the characteristic crystals of $CaSO_4 \cdot 2H_2O$ make their appearance.

Exercises for Practice.

Try reaction after the manner given above, on a salt of calcium in neutral solution. Try again in the presence of free HCl; then in the presence of free HNO_3.

Precipitate calcium oxalate, draw off the supernatant liquor, and treat the residue with dilute H_2SO_4. After examining the preparation, add more acid, and heat until white fumes appear, cool and examine again.

(See also suggestions under Barium.)

III. Sodium Tartrate added to neutral or acetic acid solutions of salts of Calcium causes the precipitation of Calcium Tartrate.

$$CaCl_2 + HNaC_4H_4O_6 = CaC_4H_4O_6 \cdot 4H_2O + NaCl + HCl.$$

Method.—To a drop of the solution to be tested add a little sodium acetate and a little acetic acid, then add a fragment of sodium tartrate. In a few moments crystals of calcium tartrate separate near the spot where the reagent was added. These crystals are large, colorless, transparent, and well developed prisms belonging to the orthorhombic system (Fig. 47).

Fig. 47.

Remarks.—The reaction is apt to fail in the presence of free mineral acids owing to the solubility of the calcium tartrate; hence the reason for the addition of the sodium acetate. The calcium salt is also soluble in sodium and potassium hydroxides.

A little free acetic acid favors the formation of well developed crystals.

If the solution is too dilute no crystals will appear for some little time. On the other hand, too concentrated solutions give rise to the immediate precipitation of crystallites and imperfectly developed prisms.

Strontium gives a tartrate isomorphous with that of calcium and hence not to be distinguished from the latter, although there is a decided tendency on the part of the strontium salt to form shorter and therefore proportionally stouter prisms.

Barium is precipitated in the form of a fine powder.

Lead is at first thrown down as a fine sandy precipitate soon crystallizing in the form of irregular crystallites not to be confused with either calcium or strontium.

In the presence of magnesium the formation of the crystals of calcium tartrate is greatly retarded, and according to Behrens the crystals then formed are more slender and rod-like; in the experience of the writer, however, the formation of slender mixed crystals is seldom observed.

The tartrates of potassium and ammonium may sometimes be precipitated in forms which at first sight are difficult to distinguish from those of the calcium salt.

The testing for calcium with sodium tartrate is of little value when dealing with unknown mixtures, for in addition to the fact that the crystals of calcium tartrate cannot be distinguished from those of strontium tartrate, salts of barium,

lead, and potassium interfere. The salts of the trivalent metals and of boric acid prevent the formation of characteristic crystals.

With simple salts of calcium the reaction is a beautiful one, leaving little to be desired.

Exercises for Practice.

(See under Strontium.)

IV. Potassium Ferrocyanide added to solutions of Calcium salts in the presence of ammonium chloride, gives rise to the formation of a Double Ferrocyanide of Potassium and Calcium.

$$CaCl_2 + K_4Fe(CN)_6 = K_2CaFe(CN)_6 \cdot 3H_2O + 2KCl.$$

Method.—To the drop of the solution of the substance to be tested add a trace of acetic acid, then a moderate amount of ammonium chloride, stir thoroughly and cause a drop of a solution of potassium ferrocyanide to flow into the test drop. Near the zone of union tiny rectangular and square plates are immediately precipitated (Fig. 48).

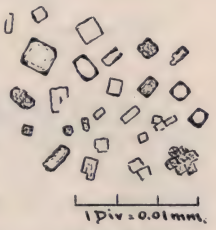


FIG. 48.

Remarks.—In the presence of free mineral acids, first add ammonium acetate or sodium acetate in order to mitigate their action.

Concentrated solutions, with respect to calcium, lead to the precipitation of an amorphous product. Too much ammonium chloride produces a like result; but the reagent alone, in the absence of the ammonium salt, unless added in considerable excess, fails to yield a deposit of crystals. Barium gives large yellow rhombs with the reagent without the addition of NH_4Cl, while strontium fails to yield a precipitate in either case. Potassium ferrocyanide is, therefore, sometimes useful in dealing with mixtures of the calcium group, but as a characteristic test for calcium in simple salts it is of but little value.

All elements forming insoluble or difficultly soluble ferrocyanides interfere, and in most cases prevent the detection of calcium by the above method.

Exercises for Practice.

(See suggestions given under Barium.)

V. The addition of Arsenic Acid to ammoniacal solutions containing Calcium, precipitates Ammonium Calcium Arsenate.

$$CaCl_2 + H_3AsO_4 + 3NH_4OH = NH_4CaAsO_4 \cdot 6H_2O + 2NH_4Cl + 3H_2O.$$

Method.—To the drop of the solution of the substance to be tested add ammonium hydroxide in slight excess, and cause to flow into the test drop a drop of an ammoniacal solution of arsenic acid. There is immediately produced a heavy precipitate rapidly growing into large crystals belonging to the orthorhombic system. These crystals of the double arsenate of calcium and ammonium generally take the form of envelope-like crystallites, or if separating from dilute solutions appear in hemimorphic forms like those of ammonium magnesium phosphate, but of a greater size (Fig. 49).

FIG. 49.

Remarks.—If much ammonium chloride is present, the crystals at first formed will rapidly disappear, or there may be no separation of the calcium salt owing to its marked solubility in solutions of ammonium chloride.

The double ammonium arsenates are isomorphous with the double ammonium phosphates, a fact which is liable to give rise to errors in the interpretation of results. Moreover it happens that the usefulness of this elegant reaction is unfortunately restricted, since the elements of the magnesium group, which are often present in mixtures to be tested for calcium, unite to form double ammonium arsenates of like crystalline appearance.

Strontium forms minute stars and tiny crystalline grains, while barium yields a dense precipitate amorphous in appearance.

Exercises for Practice.

Try the above reaction on salts of calcium, strontium and barium, first alone, then in mixtures.

Try on salts of magnesium, zinc and calcium.

Try a salt of calcium in the presence of much ammonium chloride.

VI. Primary Sodium Carbonate added to solutions containing Calcium causes the separation of crystalline Calcium Carbonate.

$$CaCl_2 + 2HNaCO_3 = CaCO_3 + 2NaCl + CO_2 + H_2O.$$

Method.—Cause a concentrated solution of the reagent to flow into a drop of a dilute neutral, or ammoniacal, solution of the calcium salt. In a short time very small disks and rhombs of the compound $CaCO_3$ appear.

Remarks.—The addition of the reagent in solid form gives nearly as good results.

Warming the preparation increases the rapidity of the reaction and leads to the formation of better crystals.

Unless the test drop is quite dilute an amorphous precipitate results.

Ammonium carbonate can be substituted for the sodium salt, the crystals then differ but little if any from those obtained as above. Normal sodium carbonate produces an amorphous precipitate.

Strontium is precipitated in the form of dumb-bell shaped aggregates and in the form of "sphero-crystals." Barium gives forms somewhat similar in appearance.

Elements of the magnesium group interfere. Lithium likewise interferes. But the chlorides of iron and aluminum and the salts of boric acid have no appreciable effect on the reaction.

When in doubt as to the nature of a precipitate formed by the treatment with

$HNaCO_3$, draw off the supernatant solution, which is easily done since the crystals of calcium carbonate adhere closely to the glass slide, wash the residue, and then add dilute sulphuric acid. If the precipitate is due to calcium, characteristic crystals of $CaSO_4 \cdot 2H_2O$ appear.

In the presence of a great excess of the reagent a double carbonate of calcium and sodium separates, having the formula $CaCO_3 \cdot Na_2CO_3 \cdot 5H_2O$, which crystallizes in stout monoclinic prisms somewhat resembling the short, thin prisms of calcium sulphate. Strontium and barium prevent the formation of the double salt.

Exercises for Practice.

(See suggestions given under Zinc.)

E. M. CHAMOT.
Chemical Laboratory, Cornell University.

Course in Biology in the Horace Mann High School.*

Although the question of the arrangement of courses in natural sciences in their relation to other courses in the high school curriculum, is as yet open to various opinions from different educators, it is, however, quite generally accepted that the courses of botany and zoölogy should come early in any plan. In the Horace Mann High School, the courses in botany and zoölogy are given in the first year, and are followed by the courses in physics and chemistry. It is believed that the work in natural history appeals more strongly to pupils in their earlier years of the high school, than to those who pursue the same work later. An objection to the reverse arrangement lies in the fact that the application of the principles of physics and chemistry to botany and zoölogy must be repeated in the biological laboratory.

The course in zoölogy occupies the first half-year, followed by the botany in the second half-year. This arrangement seems most satisfactory, both because of the greater interest manifest by pupils of that age in the study of animals than plants, and because the materials for botanical work are more available in spring than in fall. Four forty-five minute periods each week are devoted to the work.

The courses as outlined are complementary to each other; for instance, the "cell" is studied in the zoölogical part of the work and is not repeated formally in the botany course.

Throughout the course in biology it is the aim to develop the scientific method of thought and at the same time impart to the student as much as possible of the subject matter of biology, and the economic importance of animals and plants. To this end, attention is given to the form and structure of living organisms and to their development, relationships, physiology and ecology.

The method of presentation of the subjects of zoölogy and botany is a departure from the so-called logical method—that of beginning with simple forms and proceeding to the complex—for the reason that this is not believed to be the best method to pursue with young students.

* Lloyd, F. E., and Bigelow, M. A. Teachers College Record, Vol. 2, No. 1.

Zoölogy (Bigelow). What should be included in an elementary course in zoölogy for secondary schools, is a problem upon which no two persons will exactly agree. Certainly one point should be borne constantly in mind, viz., that the great majority of pupils will be unable to pursue the subject further than the one course, for which reason the subject matter should be selected from the standpoint of a liberal education, as distinguished from special and technical education.

The tendency has been to present courses embracing the detailed comparative study of the anatomy of animals to the exclusion of other phases of the subject, as the natural history, physiology, etc. It is now generally recognised, that this imparts an extremely narrow view of the animal kingdom in its varied aspects. That anatomy should form a part of any course, is beyond question, but to enter into anatomical details of half a dozen types at the expense of all other points of view must be regarded as of little value in a liberal education, and furthermore as using time which should be devoted to undoubtedly more important phases of zoölogical study. The physiological side of animals has in the past received but little attention comparatively, but has been found, in the experience of the present writer, a most profitable study for secondary pupils. He believes that no other phase of zoölogical study arouses a deeper interest and appreciation, or is more spontaneously applied by the pupils in connection with study of their own life activities.

It has been, therefore, the endeavor of those who outlined the course in zoölogy for the Horace Mann High School to combine the fundamentals of morphology, physiology and natural history, and thus give the pupils the most valuable ideas of animals and the widest view of animal life. Structure and function are studied in their natural relations. The principles of physiology are introduced as the different animals are studied morphologically, each principle being exemplified by concrete application. Such specific and comparative studies are made to lead to the direct application of the principles of comparative physiology to the activities of the human body.

As stated above, the method of study is analytical, that is, the pupils begin with multicellular animals with which they are more or less acquainted, and proceed down the scale of structural and functional complexity to the simplest forms. By this method pupils are introduced gradually to the compound microscope and are therefore able to use it with a degree of intelligence when they undertake the study of microscopic organisms. Furthermore, the pupil is better able to understand the principles of physiology when concretely applied to organs of an animal in which there is considerable physiological division of labor, than were he to begin with the study of a form in which the various functions are performed by the single cell. From the standpoint of the secondary school, the simple animal appears to be, after all, the most complex for the young beginner.

The course therefore, as outlined for the Horace Mann High School, begins with the complex animal, which is examined from the several view-points of zoölogy, as anatomy, histology, embryology, classification in connection with the near allies of the introductory type, distribution and ecology, general fundamental princi-

ples of physiology, habits of life and life history. To be sure, none of these phases go far into details, but it is the aim to lay a foundation which will make later study of animals, from whatever standpoint, more interesting and more intelligible, because there is included in the foundation work those great principles of animal structure and function which are of wide interest and application. With a foundation thus gained from the careful study of a suitable representative type, the pupil is usually eager to study each animal as it is brought before him as thoroughly as the introductory type, that is, from the various aspects of zoölogy.

As an introductory type, the crayfish has some decided advantages over other forms frequently used for beginners. In the Horace Mann High School the crayfish is viewed from the view-points indicated above. The study embraces lectures, readings, recitations and laboratory work. The author gives a complete outline of the subject matter as presented to his classes, which must, unfortunately, in this review, be reduced to only the general heads, which are as follows: "General External Structure of the Crayfish," "General Internal Structure," "Introductory Microscopic Work and Elementary Histology," "Elementary Embryological Study," "General Principles of Animal Physiology as Illustrated by the Crayfish," "Summary of the Introduction."

This work is followed by a more limited survey of forms, both invertebrate and vertebrate, which are studied chiefly from the standpoint of external structure, although other phases are considered as time permits. These forms are presented in the following order:

1. *Crustaceans.*
2. *Arachnids.*
3. *Insects.*
   (*a*) grasshopper; (*b*) butterfly; (*c*) life history of cricket, beetle, bee, ant, fly, may-fly, cicada.
4. *Worms.*
   (*a*) earth worms; (*b*) flat worms; (*c*) round worms.
5. *Cœlenterates.*
   (*a*) hydra; (*b*) hydroid colony (Pennaria, Obelia, Parypha or Campanularia); (*c*) corals.
6. *Sponges.*
7. *Protozoa.*
8. *Echinoderms.*
   (*a*) starfish; (*b*) sea-urchin.
9. *Mollusks.*
   (*a*) gasteropods; (*b*) lamellibranchs; (*c*) cephalopods.
10. *Vertebrates* (*five weeks.*)
    (*a*) amphibians; (*b*) fishes; (*c*) reptiles; (*a*) birds; (*e*) mammals.

The above outline may be made the basis for a full year course with much more satisfactory results, perhaps, than for a half year course, as a year's time is none to long in which to cover the field indicated.

Botany (Lloyd).—In general the methods and aims pursued in the course in botany are similar to those indicated above for the course in zoölogy. It is the

endeavor to view plants, in all their phases, giving the student the opportunity to acquaint himself with the essentials of plant structure, physiology and ecology. The work is begun with familiar plants and is carried on through all of the groups of spermatophytes, and thallophytes. A significant feature of the course lies in the fact that those subjects, which may be found sufficiently treated in the numerous text-books and laboratory guides in prevalent use, are treated of only briefly; the time being spent on those subjects which are not so satisfactorally presented to the student through the literature within his reach.

Another point, in which the course is especially advantageous for young pupils, is that emphasis is placed upon the study, first of all, of the fruit rather than the seed, thus obviating the difficulties which present themselves in the study of some seeds. The fruit is studied in different stages in order to impart to the student the idea of development rather than a statical conception of the matter in hand.

Attention is paid to foods in plants, to digestion and to absorption, the method being physiological rather than microscopical.

Especial attention is devoted to the problem of digestion, in which the essential similarity of plants and animals is brought into prominence. In this connection the writer recommends the cocoanut and the date, as most valuable material for demonstrating the morphological facts involved.

The subject of sexual reproduction, although not neglected, is deemed less profitable for young students than the study of the vegetative body and the more readily observable phenomena of adaptation. However, it is found that the essentials of the subject may be clearly brought out in a study of such forms as Spirogyra and Vaucheria. In the study of seed plants in this connection, somewhat more attention is paid to details, and the important morphological facts involved are demonstrated by means of charts and preparations. At this time also is demonstrated the phanerogamic embryo in earlier and later stages of development, and so the study of the life cycle, which was commenced in the study of the fruit, is rounded out to completion.

Like the outline for the work in zoölogy, the course in botany is outlined in detail. Of this outline only the headings can be given here:

I. The Structure and Physiology of Plants.

1. *The Lima Bean.*
   (*a*) fruit; (*b*) seed.
2. *The Indian Corn.*
   (*a*) fruit; (*b*) embryo.
3. *The Castor Oil Plant.*
   (*a*) fruit; (*b*) seed.
4. *The Pine.*
5. *Studies in Germination.*
   (*a*) absorption of water; (*b*) rupture of seed coats; (*c*) manner in which seedlings break through the ground: epicotyl (pea), hypocotyl (castor oil), cotyledon (onion); (*d*) development of organs in embryo; (*e*) behavior of cotyledons during germination; (*f*) earlier leaves com-

pared with adult form; (*g*) production of other shoots (pea) after destruction of plumule; (*h*) etiolation.

6. *Respiration.*
7. *Nutrition* (*Foods*).
   (*a*) proteids; (*b*) starch; (*c*) sugar; (*d*) cellulose; (*e*) oils; (*f*) mineral substances.
8. *The Digestion and Absorption of Foods.*
9. *The Structure and Functions of Roots.*
   (*a*) root system of ordinary type; (*b*) absorption by roots; (*c*) mechanical fixation of the plant by means of roots; (*d*) storage of food in roots; (*e*) modification of roots correlated with parasitic habit; (*f*) mycorhizal roots, root tubercles; (*g*) air roots; (*h*) modification of roots correlated with respiration; (*i*) contractile roots.
10. *The Structure and Functions of the Shoot.*
    (*a*) the stem; (*b*) functions of the stem; (*c*) the leaf; (*d*) functions of a typical foliage leaf; (*e*) the bud.

II. A Study of Types of the Groups of Plants.

1. *Spermatophyta; Angiosperms.*
   (*a*) Willow; (*b*) Hazel and Alder, Elm and Maple; (*c*) Calla Lily; (*d*) Hyacinth; (*e*) Cypripedium; (*f*) Strelitzia; (*g*) Buttercup; (*h*) Geranium; (*i*) Abutilon or Malvavistrum; (*j*) some leguminous flower; (*k*) Azalea; (*l*) a cactus flower; (*m*) Begonia; (*n*) Dandelion or field daisy.
2. *Gymnosperms.*
   Fir, spruce or pine.
3. *Pteridophyta.*
   (*a*) Aspidium; (*b*) Equisetum; (*c*) Isoetes; (*d*) Marsilia; (*e*) Pillularia; (*f*) Salvinia; (*g*) Azolla; (*h*) Lycopodium; (*i*) Selaginella.
4. *Bryophyta.*
   (*a*) Polytrichum; (*b*) Pogonatum; (*c*) Georgia pellucida; (*d*) Funaria.
5. *Hepaticæ.*
   (*a*) Radula; (*b*) Frullania; (*c*) Scapania; (*d*) Marchantia; (*e*) Lunularia.
6. *Fungi.*
   (*a*) Agaricus; (*b*) Puccinia or Uromyces; (*c*) Morcella; (*d*) Sclerotinia; (*e*) Lichens; (*f*) Claviceps; (*g*) Cordyceps; (*h*) Penicillium; (*i*) Microsphæra alni; (*j*) Mucor; (*k*) Saprolegnia; (*l*) Yeast; (*m*) Algæ; (*n*) Schizophyta.

C. W. J.

The second summer session of the Laboratory of Biology of Tufts College will open at South Harpswell, Maine, on June fifteenth and continue until about September first. Courses in Invertebrate Zoölogy, Vertebrate Zoölogy, Botany, and Embryology will be given, as well as opportunity for special research work. The laboratory is well equipped with apparatus for ordinary investigations and has a library of several hundred volumes and pamphlets selected with reference to the work to be done. These advantages are placed at the disposal of students for the consideration of a very reasonable fee. Communications should be addressed to the director, J. S. Kingsley, Tufts College, Mass.

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Edited by L. B. ELLIOTT.

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The majority of our subscribers dislike to have their files broken in case they fail to remit at the expiration of their paid subscription. We therefore assume that no interruption in the series is desired, unless notice to discontinue is sent.

It is very evident that bacteriological methods in the diagnosis of germ diseases cannot reach their highest degree of usefulness in the prevention of epidemics, as well as isolated cases, until the general public, and even many medical men, are better informed as to the "hows" and "whys" of these methods, and are thus enabled to understand the necessity of conforming strictly to their requirements. No more convincing proof of the benefit derived by a community from culture methods and strict adherence to bacteriological precautions ought to be needed than is shown in a recently published report* of some instances, where the evidence of the bacteriologist in the diagnosis of diphtheria was taken, in spite of more or less opposition from practicing physicians not thoroughly acquainted with the value of the methods, as a basis for treatment and preventive measures. As a result in these instances, the positive cases were promptly identified and isolated, and proper treatment applied in time to check the progress of the disease; while negative cases, however suspicious their appearance in ordinary clinical diagnosis, were safely dismissed. The bacteriological methods recommended for the control of diphtheria may be summarized with great clearness in early diagnosis, early use of antitoxin, strict quarantine, release on negative cultures only, and thorough disinfection. This procedure is based on the natural history of the disease, and is the most logical, well defined and satisfactory course to pursue with a suspected case. The culture methods are simple but most reliable, and their more rapid introduction and universal application are retarded by neglect and ignorance on the part of physicians, boards of health, and men holding positions pertaining to the public health, and prejudice, due to ignorance, on the part of the laity. These difficulties must be overcome by the thorough instruction of medical men in the use of the methods and the instruction of the people through the public schools. The latter subject is just now receiving much attention from men in charge of courses of study for pupils in high schools.

A subject of so much importance to society as the prevention of the spread of germ diseases should receive sufficient attention in all public and private schools, to inform the students of the paramount necessity not only of taking every precaution against contracting infectious diseases, but when once infected of submitting to the methods prescribed by the physician; the result of which would ultimately produce a public opinion heartily in favor of better sanitation, improved methods, and strict precautions in the preservation of the public health.

* The Control of Diphtheria in small cities and country districts from the Bacteriological Standpoint. Veranus A. Moore, M. D., Cornell University.

CURRENT BOTANICAL LITERATURE.

CHARLES J. CHAMBERLAIN.

Books for review and separates of papers on botanical subjects should be sent to Charles J. Chamberlain, University of Chicago, Chicago, Ill.

REVIEWS.

Juel, H. O. Vergleichende Unterschungen über typische und parthenogenetische Fortpflanzung bei der Gattung Antennaria. Kongl. Svenska Ventenskaps-Akademiens Handlingar. **33**: 3–56, pls. 1–6, 1900.

A preliminary note announcing the discovery of parthenogenesis in *Antennaria alpina* appeared in the *Botanisches Centralblatt* about two years ago. It was also noted at that time that *Antennaria dioica* presented a very different developmental history. The author's subsequent work upon these two species is described in great detail in the present paper.

In the nucellus of *Antennaria dioica* the sequence presents nothing exceptional, the mother cell of the megaspore producing four potential megaspores, one of which continues to develop at the expense of the other three and becomes the embryo-sac, just as in other Compositæ. The antipodal cells continue to divide and form a tissue, nineteen cells appearing in one section in one of the author's figures. Fertilization of the egg takes place in the usual manner, but no double fertilization could be detected. At the first division of the nucleus of the megaspore mother cell, a reduction in the number of chromosomes takes place. The production of a row of four potential megaspores is regarded as a true tetrad formation.

In *Antennaria alpina* the mother cell of the megaspore becomes the embryo-sac directly, just as in *Lilium*, without giving rise to a row of four potential megaspores, but, unlike *Lilium* and other plants, it shows no reduction in the number of chromosomes. Prof. Juel's previous statement that the embryos develop without fertilization and that there is no fusion of polar nuclei, is repeated with more detailed evidence.

Only one plate is from camera lucida drawings, the other five being taken from photographs and photo-micrographs. The latter were made with a 2 mm. oil immersion objective. The exposures were about two minutes long and no ray filters were used. While the figures show the stages fairly well, they also show the limitations of photo-micrography in its present stage of development.

C. J. C.

Smith, R. Wilson. The Achromatic Spindle in the Spore Mother Cells of Osmunda regalis. Bot. Gaz. **30**: 361–376, pl. 22, 1900.

The object of this work was to extend our meagre knowledge of the cytology of the vascular cryptogams. In the spore mother cell of *Osmunda regalis*, Smith finds that the spindle originates out of a granular zone of cytoplasmic material which accumulates about the nucleus. The granules of this material arrange themselves into short rows concentric with the nuclear membrane. These rows of granules become massed at opposite sides of the nucleus and eventually become the cones of a bipolar spindle. The spin-

dle appears to be bipolar from the beginning, but no bodies that could be interpreted as centrospheres were found. Although tripolar spindles were occasionally met with, Smith is certain that they are not normal stages in the development of the spindle, and comes to the interesting conclusion that the spindle in *Osmunda* does not pass through a multipolar stage. To the reviewer the evidence for such a conclusion would have been more convincing had the appearance of tripolar spindles been accounted for or had more stages in the formation of the cones of the bipolar spindle been figured.

For fixing the material chrom-acetic acid and Flemming's weaker solution were employed. Chloroform was used to precede the infiltration of paraffin. The stains that gave the most satisfactory differentiation were iodine-green and acid-fuchsin, and safranin and gentian-violet. A. A. Lawson.

Brown, H. T., and Escombe, F. Static Diffusion of Gases and Liquids in Relation to the Assimilation of Carbon and Translocation in Plants. Phil. Trans. Roy. Soc. of London, **193**: 223–292, 1900.

The authors investigated the laws governing diffusion through very small apertures. They find that:

(1) The amount varies directly as the diameter of the orifice. This holds for openings 5 or 6 mm. or less in diameter. It follows that diffusion through holes 1 mm. or less is very rapid per unit of area.

(2) When the distance between the holes is ten times the diameter of the holes themselves, the amount of diffusion is the same as when a septum is wanting.

(3) These laws hold for both solutes and gases.

By analogy with the lines of force about an electrified disc, the investigators have reached the same conclusions mathematically.

Applying these results to plant structures the authors conclude that: (a) The open stomata of a normal mesophyte (*Helianthus annuus*) are sufficient for the diffusion of several times as much CO_2 as the plant actually uses. There is no need then for more stomata. (b) The limitation of the amount of CO_2 absorbed is to be looked for in the resistance to diffusion offered by the cell wall. (c) The stomata are sufficient to account for transpiration. (d) The translocation of foods is probably more largely a phenomenon of diffusion than was supposed, since .7 per cent. of opening in cell walls would permit 30 per cent. of free diffusion. The paper confirms Blackman's results (1895), and discusses the physical laws underlying them. T. C. Frye.

Chicago.

The Martha's Vineyard Summer Institute, Hyde Park, Mass., announces the summer session of the School of Nature Study to be held during July and August, 1901. Besides the School of Natural Study the Institute embraces Schools of Methods, Oratory, Languages, Mathematics, Science, and Art; information concerning which may be obtained from the President of the Institute, Dr. Wm. A. Mowry, Hyde Park, Mass.

CYTOLOGY, EMBRYOLOGY, AND MICROSCOPICAL METHODS.

AGNES M. CLAYPOLE.

Separates of papers and books on animal biology should be sent for review to
Agnes M. Claypole, Sage College,
Ithaca, N. Y.

CURRENT LITERATURE.

Sjöbring, N. Ueber das Formol als Fixirungsflüssigkeit. Allgemeines ueber den Bau der lebenden Zellen. Anat. Anz. **17**: 273–304, 3 Abb., 1900. Abstract in Zeis. f. wiss. Mikr. u. f. Mikr. Techn. **17**: 337–340, 1900.

The author says that the opinions of formol as a fixing fluid are not, in general, favorable. Many writers say it is decidedly unfitted for the finer preservation of cell tissue. According to the writer formol does not merit this condemnation, caused by the fact that these writers have failed to discover the small point upon which the successful use of formol depends. A distinction is made between the "Formol" of the firm, Meister, Lucius, u. Brüning, Höchst a Main, and the "Formalin" of Actien (Schering) of Berlin. Formalin is not so suitable for histological work as formol. It must be understood that formol is only a fixing agent, not a hardener. Material fixed in formol should be hardened in 95 per cent. alcohol for 48 hours or longer, at least mammalian tissue should be so treated. For tissue containing much water, different strengths of alcohol are desirable. For Anodonta, 50 per cent. alcohol is most favorable. It is probably this point that causes the various results obtained by authors in the use of formol. The action of formol on tissue is probably an oxidation similar to that of osmic acid. The first requisite for a successful fixing fluid is that it should be approximately isotonic with the protoplasm. Formol, in comparison with the tissues of mammals, should have the isotonism of 8 to 10 per cent. formaldehyde (1 pt. formol to 4 of water), but not all tissues have the same tension. For mammals, the following process gives the best results: Fixation in formol, 1:4 water for 48 hours or longer; direct into 95 per cent. alcohol for at least two days. In this way the resting nuclei, red blood cells, intracellular cement between epithelial cells, fibrin, fibrinoid degeneration of connective tissue, gelatinous and other albuminous exudates, are especially well preserved. The metakinetic stages of mitosis are not successfully obtained. Formol is not especially good for nerve-tissue—preservation is good, but the staining capacity is lessened—stronger and warmed stains are necessary. Some methods of staining are especially applicable after formol fixation. Heidenhain's iron-alum-hæmatoxylin is especially good when used in a modified way. Strong solutions were found most effective. Hæmatoxylin of a concentrated aqueous solution and iron-alum for the mordant, in a 5 per cent. solution, allowed to act for three hours. For differentiation, the same strength or a one-half dilution was used. The stain was allowed to act for one hour, with some warming. Anilin blue was used for a preparatory stain; concentrated alcoholic solution in 50 per cent. alcohol was diluted one-half with water. Crystal-violet in a 1 per

cent. solution in 50 per cent. alcohol; counterstaining in orange or eosin is very satisfactory. This brings out very clearly and beautifully almost all kinds of granules. Bordeau red is not so good as with sublimate and alcoholic fixation. Another method which gave good results in many cases where iron hæmatoxylin failed, is anilin-water, fuchsin-anilin blue, according to Lugol's mixture. Ehrlich's triacid is very good in tissues where cell infiltration has occurred, but is uncertain in action. The stain must be made very concentrated in the original solution by warming it during the process. Taking up the stain with blotting paper, and decolorizing with 95 per cent. alcohol is the best method. The results after treatment with alcohol, acid, neutral or alkaline, differentiate connective tissue cell granules, neutrophil and eosinophil granules, plasma-cell granules, and clasmatocyte granules. Formol is as good for purposes of studying the cell body as is Flemming's solution for the study of the nucleus. It is especially necessary for the pathologist to make himself familiar with cell morphology under all normal and post mortem conditions before the method is applied to pathology. The method gives very fine differentiations, but must be used with great care. As a point of warning, the author speaks of the necessity of killing the animals used for cellular physiology by other means than chloroform, since the action of this substance is to decrease the staining capacity of red blood-cells in iron-hæmatoxylin, and to make noticeable changes in the cell granules, especially those of the liver and marrow cells. Guinea-pigs are killed by a blow on the back of the neck, and mice by cutting off the head with shears, etc. There is great difference in the staining capacity of different elements of the cell; liver, kidney, and bone-marrow are the easiest to stain, while those of the intestine or stomach epithelium are difficult, and the larger granules of the salivary glands always remain unstained. Those elements that do not stain in iron-hæmatoxylin can often be brought out by anilin-fuchsin, Ehrlich's triacid, etc. If large and small granules are present in the cells, they often stain differentially.

A. M. C.

Jolly, M. J. Recherches sur la division indirecte des cellules lymphatique granuleuses de la mole des os. Arch. d'Anat. Microsc. **3**: 168–228, 2 plche., 1900. (Reviewed in Zeit. f. wiss. Mikros. u. f. Mikros. Tech. **17**: 360–363, 1900).

The author gives first an extended historical review of the subject. His studies were chiefly on adult mammals. In the laboratory, the Cobaya rabbit, rat, mouse, dog, and cat; from the market, calf, sheep, hare. Some rarer mammals, the bat and mole; finally, man in several stages, were studied. Besides these, the pigeon, hen, duck, and lizard were also examined. Red marrow from the long bones was always used, in addition to that from the sternum and the body of the vertebræ. In the lower mammals there is a distinct separation between the red and yellow marrow, which is less easily found in man. This is partly due to the uncertainty as to whether the marrow was perfectly normal in the material in use. The bone marrow of thirteen infants was examined, varying in age from eight days to two years, which died of various diseases. The structure of the femur was always the same; in the middle of the diaphysis is a short canal filled with red marrow; farther towards the epiphysis is a spongy bone-tissue filled with red marrow. This was very rich in cells, excepting in the case of two individuals who died of hereditary

syphilis. In these the marrow was comparatively deficient in lymph cells. With the adult man red marrow was always found in the spongy tissue of the sternum and the bodies of the vertebræ; and being more easy of access, this was usually the source of material for this investigation. To obtain the marrow fresh, the bones, after being freed from all other tissue, are split lengthwise by a sharp stroke on a strong knife. The lymph-cells of the marrow were examined fresh in blood serum, and also after fixation in 70 per cent. alcohol, and staining in picro-carmin, and mounting in glycerin. For nuclear studies, Malassez's method of 1882 was used. A slide is laid gently upon the fresh marrow, and the smear is fixed in osmic acid fumes. The results of this method are an improvement on the old smear method, since it avoids tearing and distorting. Such a spot shows three zones; a central, the largest of considerable thickness not available for study, a peripheral, very thin, of a single layer of cells. This is generally changed by drying slightly. Also, there is a middle zone, thin enough for observation and thick enough to show no effects of drying. Fixation fluids are poured directly upon the slide; later washing loosens the thick central piece, but the rest remains in place. Besides osmic acid, the author has used Flemming's solution, sublimate with platinum-chloride, and Zenker's fluid. Osmic acid, 1 per cent. solution, for 30 to 60 seconds, gave good preparations, but Flemming was still more satisfactory in a strong solution. For staining, the following combinations were used: hæmatein and eosin, hæmatein and aurantia, hæmatein and acid fuchsin, methylen blue and eosin, methylen green and acid fuchsin. The Ehrlich-Biondi-Heidenhain triacid mixture and safranin, with potassium permanganate (1 to 100), as a mordant. According to Henneguy's method, gentian-violet, thionin, and polychromic methylen blue of Unna, were all used. The general method of preparation was as follows: a small spot of marrow is fixed in Flemming's fluid (strong) 10 to 15 minutes, washed out in running water for 15 minutes, bleached in iodin solution (1 to 100.95 per cent. alcohol) for one second, washed in 95 per cent. alcohol to remove the iodin; wash out in water, stain with a solution of eosin containing glycerin (dry eosin 1 part, 95 per cent. alcohol 20 parts, glycerin 50 parts, and water 50 parts) for a long time, so as to over stain. Decolorize in alcohol, and stain the nucleus with the following hæmatein (hæmatein 1 part, 95 per cent. alcohol 25 parts, 5 per cent. solution of ammonia alum 200 parts); wash in water, alcohol, clear in clove oil, and mount in Damar balsam. In such preparations the middle of the spot, as already mentioned, is thick and badly fixed. This is removed with a needle, if it has not already fallen out in the various washings. The cells of the peripheral zone, which have been changed already through drying, show a weakly stained and diffuse nucleus. In the middle zone the cells are well fixed and stained; red corpuscles are orange, nuclei of lymph-cells violet, protoplasm of these is grey, eosinophil granules are red. Dry preparations, fixed by heat, are useful with reference to histo-chemical reaction, but are useless for nuclear study. By drying its structure is altered; it stained uniformly and slightly. The changes are similar to those in peripheral zone of spot. The appearance of these altered nuclei explains the definite appearance of normal blood. The diffuse nuclei of certain leucocytes, the large mono-nuclear forms, are brought out by drying. The author has verified his results by sections. The marrow was imbedded in gum or paraffin. A. M. C.

CURRENT ZOÖLOGICAL LITERATURE.

CHARLES A. KOFOID.

Books and separates of papers on zoölogical subjects should be sent for review to Charles A. Kofoid, University of California, Berkeley, California.

Wilson, H. V. Notes on a Species of *Pelomyxa*. Amer. Nat. **34**: 535–550, 1900.

The species here described, *P. carolinensis*, is especially favorable for laboratory use on account of its large size and freedom from foreign inclusions. In sections it affords fine material for the study of the structure of protoplasm. Strong acetic carmin (45 per cent.) was used in killing and staining for whole mounts in glycerin. The external form and the internal structure were better preserved by this method than by others. The author regards the "refractive bodies" as globules of an albuminous nature. The culture methods employed in rearing this rhizopod are of especial interest since they are applicable to other *Rhizopoda*, such as the various species of *Amœba*. A wooden tub is filled with ordinary creek sand to the depth of four inches and flushed until the water remains clear. A handful of *Nitella*, two or three opened mussels, and fragments of a crayfish are partially buried in the sand and the tub is placed in a moderate north light. As decomposition progresses a stream of soft water is turned on for a short time every few days. After an interval of two to eight weeks *Amœba proteus* appears in numbers on the surface of the sand and sides of the tub, the smaller forms, *A. radiosa* and *A. limax*, appearing earlier. The cycle of life in such a culture is somewhat constant. Bacteria appear first and are followed by the flagellate, and then the ciliate infusoria, especially *Stentor cæruleus*. Later still the rotifers and *Entomostraca* appear. *Cyclops* becomes abundant apparently at the expense of the rhizopods. Care should be taken not to introduce the oligochæte worm *Tubifex*, which also multiplies rapidly and quickly destroys most of the bottom forms. The brown film adhering to the sides and bottom of the aquarium harbors the rhizopods and *Stentors* in large numbers. C. A. K.

Stolc, A. Beobachtungen und Versuche über die Verdanung und Bildung der Kohlenhydrate bei einem amöbenartigen Organismus, Pelomyxa palustris Greef. Zeitschr. f. wiss. Zool. **68**: 625–668, 2 pls.

Pelomyxa was collected and placed in a large glass dish filled with swamp water, and containing the other swamp organisms collected at the same time. The evaporation was made good with tap water, and at intervals little pieces of gelatin and clean filter-paper or cotton placed in the jar. Under these conditions *Pelomyxa* flourished, the individuals being usually found collected about the filter paper and cotton. The oligochæte *Dero* and the sensitive infusorian *Spirostomum* also did well.

To isolate the animals for feeding experiments they were placed in small dishes immersed in the water of the culture jar and sometimes covered with a cover-glass. If the small dishes were removed from the culture water *Pelomyxa* developed abnormally and soon died. The food was always solid; starch, glucosides, cellulose, and dried and powdered proteids being injested without

difficulty. With glycogen and the fats, however, special methods were necessary. Glycogen was mechanically united to albumin by dissolving large quantities in egg-albumin and coagulating with heat. The mixture was then dried, powdered and fed, the results showing that glycogen had been injested with the albumin. In the case of the fats an emulsion of fish oil in albumin was treated in the same way, and, after feeding the dried albumin, oil globules could be seen within the cytoplasm.

The results obtained concern almost entirely the refractive bodies which are present in great abundance within the cytoplasm, and are easily and constantly affected by certain kinds of foods. The principal results are:

1. The refractive bodies are, in the main, composed of glycogen, surrounded by a membrane of less soluble carbohydrate.

2. During starvation the refractive bodies decrease in size, the glycogen disappearing, until finally nothing but the membrane remains.

3. If now the animal be fed with carbohydrate food (starch, glucoside, glycogen, cellulose) glycogen is stored in the refractive bodies and they increase in size.

4. Proteids, gelatin, and fats cause no change in the refractive bodies, although the injested food particles are gradually dissolved.

FRANK W. BANCROFT.

University of California.

Senn, G. *Flagellata* in Engler and Prantl "Die Naturlichen Pflanzenfamilien." I Theil, 1 Abth. Lief. 202, 203, pp. 93–192, 1900. Leipzig. W. Englemann.

Both botanists and zoölogists will be interested in Dr. Senn's able monograph of this borderland group of organisms. The following orders are included: *Pantostomatineæ*, *Protomastigineæ*, *Distomatineæ*, *Chrysomonadineæ*, *Cryptomonadineæ*, *Chloromonadineæ*, and *Euglenineæ*. The work includes a comprehensive biological discussion of the group and keys to the genera, with very full descriptions. Abundant illustrations serve to characterize many of the species. Bibliographies are also very complete. Investigations since the publication of the monographs of Bütschli and of Klebs have greatly increased the number of known flagellates so that this revision of the group was much needed and will be welcomed by all who have to deal with these widely distributed and biologically important organisms. C. A. K.

Johnston, J. B. A Sealing Stone Jar for Zoölogical Laboratories. Amer. Nat. **34**: 969–971, 1900.

Stone jars eight to twenty-four inches in height and ten or twelve in diameter are made by the Zanesville Stoneware Co., Zanesville, O. The rim of the jar bears a groove to be filled with the sealing fluid. A dependent flange on the lower surface of the lid fits into the groove, thus sealing the jar. The edge of the lid projects so as to protect the rim of the jar from dust. For daily class use water may be used as a sealing fluid, while for permanent storage a very heavy paraffin oil is necessary. Lighter oils or glycerin do not make good sealing fluids. The moderate cost, large storage capacity, slight risk of breakage, the large mouth, and above all the ease of opening and resealing make this an ideal storage jar for laboratories and museums.

C. A. K.

NORMAL AND PATHOLOGICAL HISTOLOGY.

JOSEPH H. PRATT.

Harvard University Medical School, Boston, Mass., to whom all books and papers on these subjects should be sent for review.

Vogel, K. Zur Histologie der Pneumonia fibrosa chronica. Ziegler's Beiträge, **28**: 179, 1900.

The author studied light cases in which the fibrinous exudate of an acute lobar pneumonia was being replaced by connective tissue. The origin and development of the new connective tissue was investigated.

Several staining methods were employed. Unna-Tanzer's orcein solution followed by Loeffer's alkaline methylen blue yielded the best results. Orcein colors elastic tissue brown.

(1) Stain 6 to 24 hours in the following fluid:

Orcein,	0.5
Absolute alcohol,	40.0
Distilled water,	20.0
Hydrochoric acid,	0.5

(2) Wash in water.

(3) Decolorize about 30 minutes in—

Hydrochloric acid,	5.0
Alcohol,	100.0
Distilled water,	20.0

(4) Wash in water.

(5) Stain 5 to 15 minutes in Loeffer's alkaline methylen blue solution.

(6) Decolorize for a few minutes in 70 per cent. alcohol.

(7) Absolute alcohol.

(8) Oil of origanum.

(9) Canada balsam.

In acute pneumonia fibrinous strands pass from the masses of fibrin in the alveoli to the alveolar walls. Some strands enter Cohn's pores and unite with fibrin plugs in other alveoli, others are attached to the wall. When resolution of the exudate fails to occur the plugs of fibrin become retracted and clear spaces are formed in the periphery of the alveoli. In early cases of organizing pneumonia, spindle shaped connective tissue cells are found on the surface and pushing their way into the interior of the fibrin plugs, and spindle cells are also seen advancing along the threads of fibrin which pass through Cohn's pores. The connective-tissue fibrillæ form at first a loose network which contains in its meshes many plasma cells. In one case new-formed elastic fibers were demonstrable.

Cohn thought that the connective-tissue arose from the inter-lobular and subpleural tissues. Ribbert asserted that the formation began in the smallest bronchi and the bronchioles. Vogel opposes both these views. In the first stage of organization he found young connective-tissue outgrowths springing from the

alveolar wall and extending along the fibrinous strands. He concludes that organization proceeds (1) from the alveolar wall into the fibrin plugs; (2) from one fibrin plug to another by the growth of connective-tissue through Cohn's pores. J. H. P.

Flexner, S. Nature and Distribution of the New Tissue in Cirrhosis of the Liver. (Preliminary Communication.) Trans. Asso. Am. Phys., **15**: 523, 1900.

In this study account was taken of the normal and pathological distribution of the reticulum, the white fibrous tissue and the elastic tissue.

Two methods were employed for the demonstration of the elastica. The first was Unna's orcein stain, the other that of Weigert, which employs a resorcin and fuchsin combination. Unna's method was unsatisfactory, because the staining was irregular and inconstant. Weigert's method gave uniformly good results.

For the purpose of demonstrating the reticulum, the digestive method, as first introduced by Wall, as well as the modification of Spalteholz, were utilized. By these methods both fresh and preserved tissues in sections are digested in alkaline solutions by means of pancreatin, when the parenchymatous cells and elastic tissue are completely removed. There remains behind a framework consisting of white fibrous tissue and reticulum.

In the study of the white fibrous tissue stained sections, both before and after digestion, were employed. Mallory's specific stain was found of especial value in demonstrating the fine fibrils of white fibrous tissue contained within the liver lobules; but inasmuch as this stain also colors the reticulum its use is somewhat more limited than could be wished; on the other hand, it apparently leaves the elastic fibers unaffected.

From his study he drew the following conclusions:

1. In all forms of cirrhosis the white fibrous tissue is increased.

2. Along with the increase of white fibrous tissue there is a new formation of elastic tissue. This new elastic tissue is derived from pre-existing tissue in the adventitia of blood vessels and the hepatic capsules.

3. Both white fibrous and elastic tissue, in all forms of cirrhosis, may penetrate into the lobules. This penetration takes place along the capillary walls or follows the architecture of the reticulum. The chief distinctions between the histology of atrophic and hypertrophic cirrhosis depend upon the degree of extra lobular growth and the freedom with which the lobules are invaded. In hypertrophic cirrhosis there would appear to be less interlobular growth, and an earlier and finer intralobular growth.

4. The alterations in the reticulum, *per se*, consist, as far as can be made out at present, of hypertrophy rather than hyperplasia of the fibers. It is still uncertain whether any of the differential methods now in use suffice to distinguish between the reticulum and certain fibers derived from the white fibrous tissue of the periphery of the lobules. J. H. P.

GENERAL PHYSIOLOGY.

RAYMOND PEARL.

Books and papers for review should be sent to Raymond Pearl, Zoölogical Laboratory, University of Michigan, Ann Arbor, Mich.

Holt, E. B., and Lee, F. S. The Theory of Phototactic Response. Amer. Jour. Physiol. **4**: 460–481, 1901.

In the literature dealing with the effect of light on the movements of organisms two modes of action of the stimulus have frequently been distinguished; one through the direction of the rays, and the other through the intensity of the light. It is the purpose of Holt and Lee to determine to what extent the direction of ray *per se* is effective in producing the orientation of an organism to light. The two leading theories of light response, those of Loeb and Verworn, are carefully outlined, and that of Verworn is "provisionally adopted," because it seems to the authors to be more explicit and capable of being applied to all the facts than the other. Four typical cases of light reaction are examined. The first and simplest reaction considered is that described by Strasburger for swarm-spores. These organisms move away from the light in strong illumination and towards it in weak. This is explained according to the Verworn theory as due, on the one hand to contraction phenomena induced by supra-optimal stimulation of one side in strong light, and, on the other hand, to expansion phenomena induced by sub-optimal stimulation of one side in weak light. This results in movement towards the optimum intensity in any case. The second point considered is the reaction of an animal exposed to light from two sources. The crustacean *Lynceus* was experimented on and found to move away from two lights of equal intensity along a path which equally divided the angle formed by the light rays striking the animal from the two sources. This again is evidently what would be expected from Verworn's hypothesis, since the path taken is such as would cause the two sides to be illuminated by light of equal intensity. The third case of phototactic phenomena treated is the response of an animal exposed to light rays coming vertically through a prismatic screen. By such an arrangement one end of the vessel is made darker than the other, independently of the direction of the rays. *Lynceus* and *Stentor* were used for experimentation. Both went to the dark end of the vessel along a more or less diagonal course. The explanation is that the animal shows contraction phenomena on the supra-optimally stimulated side until the body is in such a position that both sides are stimulated with equal light intensities. The simple diagonal path is in most cases modified by the fact that the animals strike the back wall of the containing vessel and are veered off by it, but necessarily in the general direction of their previous course. The fourth type of reaction considered is that shown by animals under the same experimental conditions as in the last case except that the light comes obliquely instead of vertically through the prism. Under these conditions a negatively phototactic animal will go into regions of brighter illumination, along a path more or less parallel to the direction of the rays. The authors show that it is possible to

explain this reaction as a result of the attainment of a position of equal bilateral stimulation by the same sort of contraction processes on the supra-optimally stimulated side as in the other cases.

The principal conclusion is that: "Light acts in one way, that is, by its intensity. The light operates, naturally, on the part of the animal which it reaches. The intensity of the light determines the sense of the response, whether contractile or expansive; and the place of the response, the part of the body stimulated, determines the ultimate orientation of the animal." Under ordinary circumstances the part of the body stimulated is, of course, a direct function of the direction of ray. The paper shows clearly that the *orienting* "photopathic" reaction is very probably the same thing as the response ordinarily known as "phototactic." R. P.

Bardeen, C. R. On the Physiology of the *Planaria Maculata* with especial reference to the Phenomena of Regeneration. Amer. Jour. Physiol. **5**: 1–55, 1901.

The aim of this work is to determine some of the internal conditions of regeneration in the common flatworm, *Planaria maculata*. The account of the regeneration work is prefaced by sections devoted to the general anatomy and physiology of the animal. In the account of the physiology "sensation" is discussed in a very general way. The work of Loeb on the light reactions of the worm is mentioned and a very brief description is given of the reactions to contact stimuli. In this section the author makes the surprising statement that he has not found that "the worm is sensitive to anything but light and contact." Under "Movement" two sorts of progression, "swimming" and "crawling," are described. The "swimming," by which term the author evidently intends to designate the motion of the worm ordinarily spoken of as "gliding," is almost entirely due to the action of the cilia covering the ventral surface of the body. The crawling is an entirely muscular movement brought about by waves of contraction passing from the anterior to the posterior end. Experiments on the central nervous system showed that, at any level, it is capable of governing the activities of all parts of the body posterior to that level. Under "Internal Activities" are discussed the processes of deglutition, food-dispersion, defecation and respiration. Food is taken in by peristaltic contractions of the pharynx and then distributed evenly through the branches of the intestine by contractions of the body wall. Digestion is mainly intracellular. Defecation is brought about by a series of sharp contractions of the whole body while the pharynx is held open. There are a few brief and rather loose statements in regard to respiration and excretion. The part of the work devoted to the general physiology of the animal is, on the whole, weak and unsatisfactory. The remainder and larger part of the paper is devoted to a detailed study of the cellular processes taking place during regeneration. Most of the gross forms of regenerated animals which have been obtained by other workers on the same subject are carefully described with reference to the details of their development. The processes occurring after the removal of a part of the animal are briefly as follows: (1) The wound becomes smaller in surface area on account of the contraction of the surrounding musculature. (2) The cut surface remaining is protected by the transformation of the cells directly exposed to the water into mucoid tissue. Later the surface epithe-

lium grows out over the wound. (3) Along the cut surface and in the region just posterior to the point of least intestinal pressure, "embryonic tissue" is formed. This embryonic tissue comes from the transformation of adult parenchyma cells. (4) The next stage in the process is the differentiation of the embryonic tissue. This differentiation depends on the relation of the tissue to the intestinal apparatus in general, and to the axial gut in particular. Tissue at the anterior end of the axial gut forms a head, at the posterior end a pharynx, and behind the pharyngeal region a tail. The reason for this relation of the differentiation of tissue to the digestive system the author believes is to be found in the action of "nutritional currents of a specific direction, intensity, and force." The idea is a suggestive one and the experimental results give it considerable probability. R. P.

CURRENT BACTERIOLOGICAL LITERATURE.

H. W. Conn.

Separates of papers and books on bacteriology should be sent for review to H. W. Conn, Wesleyan University, Middletown, Conn.

Jordan. Some observations upon the Bacterial Self-purification of Streams. Jour. Exp. Med. **5**: 271, 1900.

Dr. Jordan has contributed an interesting and timely article on the problem of the disappearance of bacteria in flowing streams by an exhaustive study of the bacteria in the Illinois river, which has, in the last year, been converted into a drainage system for Chicago, emptying into the Mississippi river, after flowing 318 miles. The pollution of this stream with the sewage of Chicago has alarmed the people along its banks, particularly in St. Louis, which city takes its supply of water from the Mississippi river, some four miles below the outlet of this system of sewage. A study of the bacteria of this river has been made with extreme care, and the bacterial contents of the river, at different distances between Chicago and the Mississippi outlet, have been determined. The result shows that the number of bacteria in the river falls rapidly, and at its outlet apparently all of the bacteria which came from the sewage of Chicago have disappeared, since there are no more bacteria in the river at that point than are contained in the ordinary tributaries of the river. The river, therefore, purifies itself and Chicago sewage does not materially pollute the Mississippi river. The author also considers the causes of this disappearance of bacteria without, however, reaching very positive conclusions. He is inclined to believe that the exhaustion of the food supply is one of the most important factors. H. W. C.

Ford. The Bacteriology of Healthy Organs. Transactions of the Association of American Physicians. **15**: 389, 1900.

Bacteriologists, in the past, have been of the opinion that the organs of healthy individuals are sterile, and that it is only under conditions of disease that bacteria invade the tissues. This opinion has been questioned occasionally, but no very definite conclusion has been reached. Ford, desirous of settling this question, performs a long series of very careful experiments. His method of work appears to be beyond criti-

cism. He has experimented with several species of animals, and has studied, in all, thirty-five different individuals. His conclusion is emphatic and decided. In eighty per cent. of the organs studied, positive evidence has been found of the presence of micro-organisms in the normal tissue of the healthy individual. Seventy-seven per cent. were demonstrated by growth in culture media, and the other cases only by the microscopic presence of bacteria in the organ. He found that each species of animal showed its own peculiar bacteriology; that each animal showed a distinct bacteriology; that the different organs showed the same bacteria on different media, although different culture media furnished a variety of species. The bacteria found were ordinary species, including staphylococci, bacilli, and proteus forms. H. W. C.

Wakker. Wakker's Hyacinth Germ Pseudomonas hyacinthi (Wakker). Bull. Div. of Plant Phys. and Path. U. S. Dept. of Agri. **26**: 45, pl. 1.

Dr. Erwin F. Smith's paper on Wakker's Hyacinth Germ is a noteworthy contribution towards a better knowledge of the parasitic bacterial diseases of plants. The paper, though ready for publication in 1897, has been withheld till now to learn why such meager growth was obtained on the host plant. The *Pseudomonas hyacinthi* (Wakker) (E. F. Smith) is a yellow rod-shaped organism, non-sporiferous, color distinctly yellow but somewhat variable; old cultures on some media darken from the production of a soluble pale-brown pigment. This color was not observed in acid or alkaline beef broth, on cocoanut flesh, on sugar beets, in nutrient starch jelly, in agar, or in gelatin with or without sugar. The organism is pathogenic to hyacinths. The host plant is not rapidly destroyed, the cells first separate by solution of the middle lamella. The cavities contain large numbers of bacteria. It is closely related to *Ps. campestris*, parasitic or cruciferous plants, *B. phaseoli* on beans, *Ps. stewartii* parasitic on corn, especially sweet corn. The daughter bulbs contract the disease from mother bulbs. The bulbs may sometime contract the disease from germs lodged in the flowers. A more extended contribution has been promised. The paper is one well worthy of copying as a model for this kind of work. L. H. Pammel.

Jones. Soft Rot on Carrot and Other Vegetables. Bacillus carotovorus (Jones). Rep. Vt. Agri. Exp. Sta. **13**: 299–332, fig. 11.

This paper deals with a soft rot of carrot found in Vermont. The organism *Bacillus carotovorus* (Jones) causes a rapid soft rot of carrots which resembles Heinz's white rot of hyacinths and Potter's white rot of turnip. It causes the rapid disorganization of the tissues apparently due to an enzyme cytase, excreted by the bacteria, which softens the middle lamellæ of the cell walls and causes a breaking down of the intercellular substance. Wound infections led to decay in a large number of plants such as the carrot, parsnip, salsify, cabbage head, etc. The organism producing this disease is a bacillus having vibratory motion, oscillating or darting in young liquid cultures. The rod is provided with two to five peripheral flagella. The author suggests that we have a considerable number of groups of closely related organisms whose differentiation will tax the skill and patience of the bacteriologist as much as the *B. coli* group. The organism was grown in a large number of different media. Of interest is the fact that its action reduces nitrates. This paper is likewise a model of its kind, especially in regard to the thoroughness of testing the organism in different media while studying its biological and pathological characters. L. H. Pammel.

Medical Notes.

Robin, A. Preservation of Sputum for Microscopic Examination. Jour. Bost. Soc. Med. Sci. **5**: 7.

The author experimented with carbolic acid 5 per cent. solution, trikresol 2 per cent., formaldehyde 5 per cent., and hydrochloric acid 10 per cent. to determine their preservative power on sputum containing tubercle bacilli. The sputum treated was examined at the end of 24 to 48 hours, after which time, weekly and then monthly examinations were made for a period of four months. Except with HCl the preservation was good and the bacilli stained deeply; HCl seemed to disorganize the bacilli. The author recommends the addition of an equal volume of a 5 per cent. solution of carbolic acid to the sputum, which should be vigorously shaken in the bottle, so as to break up the lumpy coagulation. C. W. J.

Conn, H. W. How can Bacteria be Satisfactorily Preserved for Museum Specimens? Jour. Bost. Soc. Med. Sci. **5**: 7.

In answer to this question the author offers the following method: A two per cent. agar culture medium is placed in large test-tubes which are tilted so as to make agar slants. The tubes are left undisturbed for six to eight weeks to allow the surplus moisture to evaporate. They are then inoculated in long streaks and immediately sealed with plaster of Paris and paraffin. The cultures grow for a few days, then cease growing and remain unaltered indefinitely. Only one unsatisfactory feature presents itself; viz., moisture within the tube condenses on the inside of the tube with changes of temperature, thus rendering the tube cloudy and for the time injuring the value of the display specimen. C. W. J.

Eastes, G. L. Note on the Phenyl-Hydrazin Test for Sugar. Brit. Med. Jour., Feb. 23, 1901.

Place 60 c. c. of filtered urine in a beaker of 100 c. c. capacity, add 1 gm. of sodium acetate, and a little less of phenyl-hydrazin hydrochlorate. Stir with glass rod, which is left in the mixture throughout the operation. Place beaker on water bath and allow the mixture to evaporate gradually down to 10 or 15 c. c., occasionally scraping the sediment from the sides of the beaker if such tends to collect. When reduced to the bulk indicated, remove flame and allow the liquid to cool. When quite cool examine under microscope. Ozazone crystals will have formed if there is one part per thousand or more of sugar in the urine. If no crystals are formed it may be safe to conclude that no sugar (glucose) is present. C. W. J.

Uhlenhuth. Method for the Differentiation of the Blood of Various Animals with especial Reference to the Demonstration of Human Blood. Deutsche Med. Wochenschr., Feb. 7, 1901.

If, at intervals of six to eight days, small amounts of the defibrinated blood of any animal is injected into the rabbit, changes are produced in the rabbit's blood which cause it to give a reaction with the blood of that other animal alone and with no other. If a few drops of the serum of a rabbit that has been treated with ox blood, for example, are dropped into each of a row of test-tubes containing dilute solutions of the blood of various animals, absolutely no reaction is produced in any tube except that containing ox blood, which at once shows a slight turbidity, which increases on standing and finally develops into a flocculent precipitate.

The blood of a rabbit which has been injected with human blood, furnishes an infallible reagent for detecting human blood even in very small amounts, and after having been allowed to dry for four weeks. C. W. J.

TIME WAS UP.

It Was Quit Coffee or Die.

When a woman is brought to the edge of the grave by poisoning from the drinking of ordinary coffee day by day, and is then made a well woman by leaving it off, her experience is worth something to others that are poisoned in various ways from the same habit.

Mrs. Jeannette B. Brown, 100 Minor St., New Haven, Conn., says: "Four years ago my life hung on a very slender thread with liver, kidney, and heart trouble, and a very severe form of rheumatism. I was confined to bed with hands, wrists, feet and ankles so badly swollen that they bore no resemblance to parts of the human body. I had frequent sinking spells from heart weakness, when I was thought to be dying, and sometimes thought to be dead. My doctor, one of the directors of the State Hospital, a very successful man in his profession, told me to stop drinking coffee and use Postum Food Coffee, as he said coffee was the primary cause of my trouble.

I took his advice at once and discontinued medicines. Slowly the swelling disappeared, and the rheumatism left me, the sinking spells became less frequent, and I got out of bed and around the house. I was completely cured, but it required some time.

For the past three years I have been a perfectly strong, healthy woman, sleep well, with good appetite, good color, active, and energetic.

It is a great pleasure to testify to Postum that has made me a well woman again. I have many friends here and in other parts of the state who are using Postum Food Coffee regularly, and I know to their very great benefit.

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The finest specimens of teeth are seen in animals and human beings who chew their food thoroughly.

Dentists agree that teeth must be used to properly preserve them, and therefore they urge people to chew their food thoroughly, but the nervous, hurried manner of eating is altogether too common among people, and when fed on soft mushes they are liable to swallow the food without chewing.

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Grape-Nuts food is pre-digested and also helps in the digestion of other food. The doctor's plan might do for a variety, but Grape-Nuts and cream alone are considered ideal by hundreds of thousands of brainy people.

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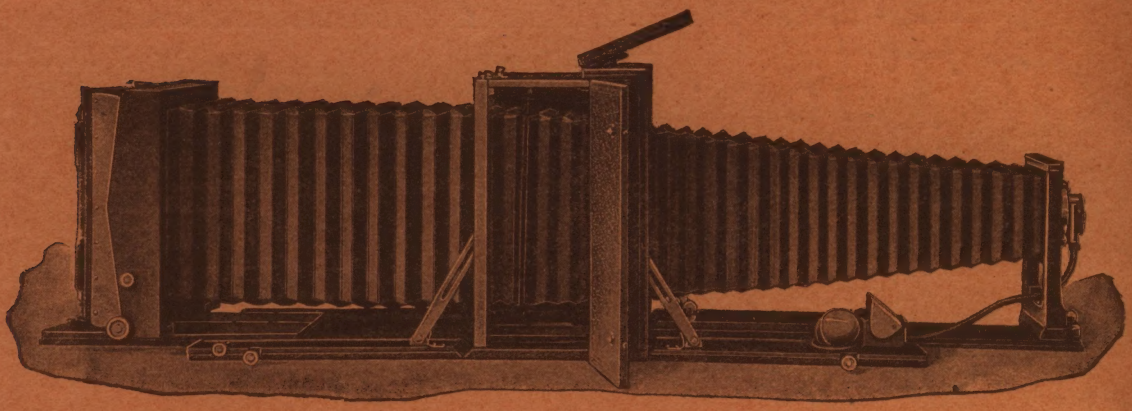

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